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ated out of the income of the Michaux Fund for the expenses of the Fifteenth Course of the Michaux Forestry Lectures by Prof. J. T. Rothrock.”

By order of the Committee,

J. SERGEANT PRICE, *Secretary*.

The Librarian reported that Dr. Elliott Coues had returned personally all the Lewis and Clarke manuscripts borrowed by him ; that the same were correct in number and condition ; that Dr. Coues had arranged them in a most excellent and careful manner, so as to facilitate all future reference ; in fact, that they were in much better condition than when loaned by the Society.

The Treasurer was authorized to receive from the city of Philadelphia the sum of \$3000 due January 1, 1894, and to sign proper quittances therefor.

And the Society was adjourned by the President.

Age of the Newark Brownstone.

By Benj. Smith Lyman.

(Read before the American Philosophical Society, January 5, 1894.)

There seems to be reasonable ground for doubt whether the rock beds of the Newark, N. J., brown building stone quarries belong even to the Mesozoic, as they have generally been thought to. In spite of the unfavorable character of the sandstone for preserving fossils, it has yielded a number of specimens, and the identification of at least two species has been attempted. In the *New Jersey State Geological Report* for 1879, p. 26, the late deeply lamented State Geologist, Prof. Cook, speaks of certain fossils at the closely adjacent Belleville quarries, evidently in the same sandy beds, as follows, citing the unexcelled authority of Lesquereux :

“At the Belleville quarries thin seams of coal and impressions of the stems and branches of plants are not uncommon. A fragment of the stem of a plant with surface markings like the *Lepidodendron* was found, and is now the property of Mr. David Hitchcock, of Orange. It is a very plainly marked, flattened stem, eight inches long, four and one-half inches wide, and one and one-half inches thick. Photographs of this

were taken and sent to Prof. L. Lesquereux, of Columbus, Ohio. He returns the following answer :

“ ‘The photographs are sufficient, if not for specific determination, at least for positive reference of the specimens to *Lepidodendron*. Even I should say that the specimens represent *L. weltheimianum* Presl as distinctly as a specific representation can be made upon a decorticated trunk of *Lepidodendron*. *L. weltheimianum* is a leading species of the old red sandstone found here, as in Europe, from the subcarboniferous measures down to the Devonian, while until now we do not have any remains of *Lepidodendron* of any kind from the upper coal measures (Permo-carboniferous), or from higher up than the Pittsburg coal.

“ ‘*L. weltheimianum* is recorded only once from the true coal measures ; this by Eichwald, from the Carboniferous sandstone of Russia. But European authors, among others Goeppert, doubt the identity of the Russian species with *L. weltheimianum*, which is moreover extremely variable, and has been described already under about thirty different names.’

“ ‘Another fragment [Prof. Cook adds] has since been obtained from the same quarries by Dr. Skinner, of Belleville, and is now in our possession. It is seven inches long, five and one-half inches wide, and one and one-half inches thick, and is as plainly marked as the first. Other and smaller specimens somewhat like the above have also been found in the quarries in Newark. If these fossils are sufficient to determine the geological age of these beds, they put it in the upper Carboniferous, at least, which is lower than has heretofore been claimed for it. A larger and more complete collection of such fossils must be made if possible.

“ ‘Vegetable impressions are found in large numbers at the quarries of Mr. Smith Clark, of Milford, but most of them are fragmentary and indistinct. Those which can be seen plainly enough for identification resemble the *Equisetum* and some coniferous plants. They are evidently much newer than the fossils at Newark and Belleville.’

It is not to be wondered at that the very sagacious Prof. Cook should have perceived this great difference in age on even so cursory an examination ; for the Newark brownstone is at least some nine thousand feet lower geologically than the Milford beds, a part of the Perkaskie shales of Pennsylvania. Few species indicating the geological age have been reported from the Milford beds ; but from the horizon of the Gwynedd and Phoenixville dark shales, far below those of Milford, and quite above the Newark beds, appear to have come most of the fossils in Pennsylvania, Virginia, North Carolina, and elsewhere, that have been thought to indicate the Rhætic age of all the older Mesozoic rocks of those States.

So fixed has become the impression of the Mesozoic age of all the beds that have hitherto commonly been grouped together under the name of the American New Red, and many other names, that it may even possibly have caused some bias in the minds of paleontologists in their determination of more or less doubtful fossils ; though Lesquereux seems not to have been fettered by such a prejudice to the extent of blindness to otherwise

clear indications. Prof. William M. Fontaine may have been guided by equally clear indications, but his expressed argument does not seem perfectly sound when he says of a "New Red" fossil described and figured by Emmons as a *Lepidodendron*, and without pointing out what else it is: "These impressions are, of course, not those of *Lepidodendron*, as this plant does not exist in the Mesozoic." That would decidedly seem to be begging the question as to the age of the fossil. Newberry appears also to have been possibly influenced by the same assumption.

In has, in fact, been generally, but perhaps too superficially, assumed from the predominance mainly of a red color, and the absence of notable unconformities in the beds of the so-called New Red, and the lack of numerous convenient fossil indications, that the beds all belonged to one formation of no wide paleontological range, and consequently of no very great thickness. Now that our Pennsylvania investigations prove beyond a doubt that the total thickness is at least some twenty-seven thousand feet, the presumption is rather that the beds should be of very diverse geological age; and even it should not seem surprising if the lower ones, including the Newark brownstone, should prove to be of Paleozoic age.

Lesquereux's very positive, unhesitating recognition of the *Lepidodendron* would of itself make it highly probable that the brownstone was at least as old as the Carboniferous; and somewhat confirmatory wholly independent fossil evidence has been found in Pennsylvania. Several years ago Mr. S. E. Paschall, of Doylestown, pointed out to Prof. Henry Carvill Lewis certain calamite fossils that had been found by Mr. John S. Ash half a dozen miles easterly from Doylestown, just north of the old Paleozoic island, so to speak, and within the limits of the supposed Mesozoic, and now known to be a couple of thousand feet geologically below the brownstone beds. Lewis thought the calamite might be of Permian age. With much search Mr. Ash succeeded in finding a specimen that contained two joints with the whole internode, some twelve or fifteen inches long, and some eight inches or more broad, and it was sent to Lesquereux for identification. Other affairs through the short remainder of his busy life prevented Lesquereux from communicating any result of his examination, and the specimen has not yet been recovered. But Mr. Paschall has a less perfect fragment ten inches long, indicating a calamite of at least six inches in breadth, with a single joint at two inches from one end. He says there are other better specimens at the Academy of Natural Sciences.

The only two recorded fossils, both plants, that have been supposed to be identified beyond doubt, from the Newark quarries, are the *Dioonites longifolius* and *Clathropteris platyphylla*, mentioned by Newberry in his Monograph xiv, of the *U. S. Geological Survey*, on "The Fossil Fishes and Fossil Plants of the Triassic Rocks," etc., 1888, pp. 93 and 94. Fontaine speaks of the *Dioonites longifolius* among the North Carolina fossils, *U. S. Geological Survey*, Monograph vi, 1883, p. 111, judging merely by a description and figure of Emmons', as probably nearly allied to *Zamites*

proximus from the Rajmahal group of India (Jurassic) ; and in describing the *Clathropteris platyphylla* from the Virginia coal measures (probably corresponding in age to the Gwynedd and Phoenixville shales, and decidedly later than the Newark beds) points out (p. 56) several differences between it and the European Jurassic plant, with which, on the whole, he thinks it should be associated. Newberry (Monograph xiv, p. 94) says that fragments of the *Clathropteris platyphylla* have been obtained, though only rarely, from the beds of Newark ; but the one he figures is from Milford, N. J., that is, some nine thousand feet above the Newark beds.

Newberry mentions (p. 86) also an imperfect Newark fossil that, "in reviewing the literature of the Triassic flora" (an expression that seems to show his inclination to assume *a priori* that the Newark beds were necessarily Mesozoic), he found to resemble the *Equisetum meriani* ; but he candidly adds : "Until the fructification of these Equisetoid plants shall be found which will permit a better comparison with those of older and later formations, it is a useless expenditure of time to discuss the question whether they are species of *Calamites* which have survived from the Carboniferous age, are true *Equiseta*, or are species of an extinct genus of that family."

Newberry further speaks of a fossil tree trunk found frequently in the sandstone quarries of Newark, resembling *Lepidodendron*, adding in regard to the idea of its being one : "This is a manifest error. *Lepidodendron* did not pass from the Carboniferous to the Mesozoic age." Evidently he took it in advance for granted that the beds of Newark could not be older than Mesozoic. It is not unlikely these very fossils are of the species so readily identified by Lesquereux with the *Lepidodendron*. Newberry thinks they are probably a *Palissya* ; and Fontaine mentions *Palissya indica*, a plant of the Rajmahal group, as occurring in North Carolina.

Apparently no other fossils have been recorded as coming from Newark ; and it is seen that only two of them have been identified with any approach to certainty. Moreover, neither of the two would seem to be so closely like the nearest European and Indian forms as altogether to preclude the possibility of their being of very different age from them, especially considering their geographical remoteness.

Rogers, in his *Final Report on the Geology of Pennsylvania*, 1858, Vol. ii, p. 507, suggests the possibility of finding Permian fossils among the highest rocks of Greene county, in the southwestern corner of the State ; and Stevenson, in his *Report of the Second Geological Survey of Pennsylvania*, 1876, shows (p. 35) that the highest known rocks there are red shales. Whether Carboniferous or Permian, it is by no means inconceivable that they may prove to be contemporaneous with the Newark beds.

The Canadian geologists have found that much of the formerly so-called Trias of Prince Edward Island, New Brunswick and Nova Scotia is really Permian, Permo carboniferous, or even Carboniferous (see the *Canada Geological Survey Reports* : Ellis, 1882-84, 1893 ; Fletcher, 1886,

1890-91). Their description of the rock-beds shows a good deal of resemblance to those of Newark. Fletcher, in his last report, gives several detailed sections of Permian rocks up to five thousand and eight thousand feet in thickness. It seems hardly probable that no traces of so vast a formation should be found in the eastern United States near either the Mesozoic or Paleozoic rocks with which it is so intimately associated in Nova Scotia and Prince Edward Island.

It would seem, then, that the Mesozoic age of the beds of Newark is not so thoroughly certain but that it might be worth while for paleontologists to reëxamine with renewed care the indications of the fossils that really bear on the point. For undoubtedly the very scanty and imperfect testimony of the fossils already known; the apparent bias, on the one hand, in favor of comparing them only with Mesozoic forms that are extremely remote at best; on the other hand, the less biased partial identification of some Newark fossils with Paleozoic ones under conditions at least equally favorable as regards skill and material; the great thickness of measures below the comparatively well-identified Rhætic or Triassic horizon of the Gwynedd and Phoenixville shales, the same probably as the Richmond and North Carolina coal-bearing beds; and the possibility, to say the least, that some of the red beds conformably at the top of the Carboniferous rocks of southwestern Pennsylvania and of West Virginia, as well as some of the Permian or Carboniferous beds of eastern Canada, may be of identical age with the Newark beds; all these circumstances make it seem not altogether improbable that the Newark brownstone is older than the Mesozoic.

Further on the Age of the Newark Brownstone.

By Benjamin Smith Lyman.

(Read before the American Philosophical Society, January 19, 1894.)

An additional reason for doubting the Mesozoic age of the Newark brownstone may be found in the remarks of Newberry on his fossil plant *Dendrophycus triassicus*, found at Portland, Conn., in sandstone of possibly the same age as the Newark brownstone. He quotes (Monograph xiv, p. 82) Lesquereux's description of *Dendrophycus Desori*, found in the Pennsylvania No. XI, or Umbral shales; and adds: "I have copied this description nearly entire because it is almost literally applicable to a plant represented on Pl. xxi of this memoir and obtained from the sandstones of Portland, Conn. When we consider the vast interval of time between the deposition of the Umbral shale of Pennsylvania and that of the Rhætic sandstone of Connecticut, one the base of the Carboniferous sys-

PROC. AMER. PHILOS. SOC. XXXIII. 144. B. PRINTED FEB. 13, 1894.